Center Innovation Fund: SSC CIF

Cryogenic Acoustic Suppression Testing

Completed Technology Project (2013 - 2014)

Project Introduction

A proof-of-concept method utilizing a cryogenic fluid for acoustic suppression in rocket engine testing environments will be demonstrated. It is hypothesized that the energy required to heat a cryogenic, such as liquid nitrogen, will not only decrease the thermal energy of the exhaust but the acoustic energy as well. A scaled aspirator will be designed and contain the spray ring to inject the acoustic suppression fluid into the exhaust. Water, the typical fluid used for this application, will be used in this research as a baseline for the cryogenic results. Experimental testing of the concept will be accomplished using infrastructure that was designed and built under a previously funded CIF project. Once the principals are understood, the method could be economically scaled for deployment within full-size rocket engine testing environments. This is a futuristic endeavor with a potential to reduce cost and risk associated with rocket engine testing.

The proposed project will explore and test the feasibility and effectiveness of using a cryogenic fluid (liquid nitrogen) to facilitate acoustic suppression in a rocket engine testing environments. Typically, a pressurized water "curtain" is used to provide acoustic suppression. Achieving the volume and flow rates of the water required to suppress acoustic reverberation is extremely energy intensive and, often can limit the test duration or profile. In recent years, investigation into acoustic suppression using water has been explored which has included the development of some empirical relations so that levels of acoustic suppression can be assessed. However, most relations developed are simplistic, and merely scale the total mass flow rate or momentum of the propellants to determine the optimal water volume required. Therefore, for this project, the utility of cryogenic fluid to suppression acoustic energy will be explored to assess its utility in a rocket engine testing environment.

Anticipated Benefits

The cryogenic acoustic suppression testing will directly benefit NASA funded missions by minimizing the copious amount of cooling water and plumbing required for long duration rocket engine/stage testing. Generation of initial data sets that will be used to anchor models or determine relations/correlations.

Logo for the Office of the Chief Technologist

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Stennis Space Center (SSC)

Responsible Program:

Center Innovation Fund: SSC CIF

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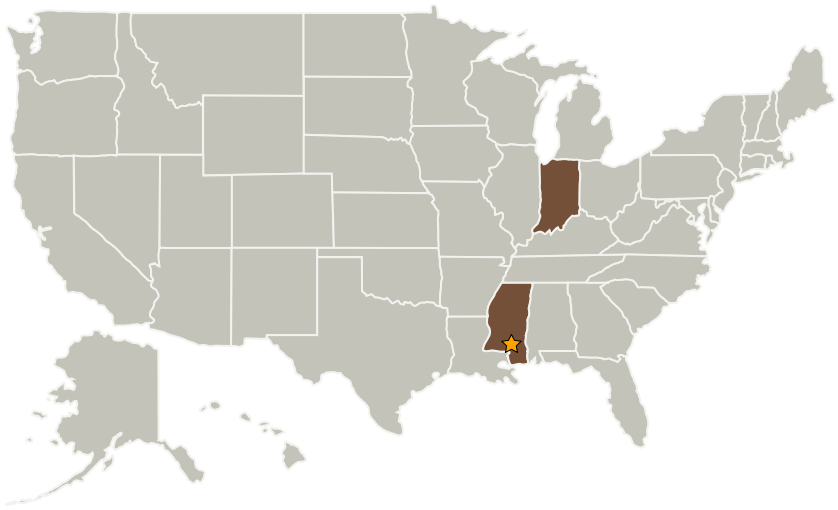
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Stennis Space Center(SSC)	Lead Organization	NASA Center	Stennis Space Center, Mississippi
Purdue University-Main Campus	Supporting Organization	Academia	West Lafayette, Indiana

Primary U.S. Work Locations	
Indiana	Mississippi

Project Management

Program Director:
Michael R Lapointe

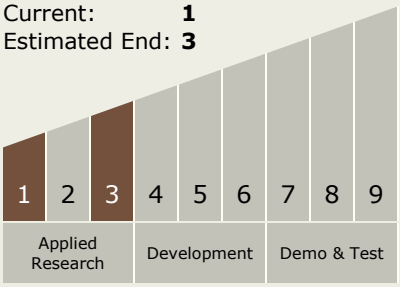
Program Manager:
Ramona E Travis

Project Manager:
Nicholas J Nugent

Principal Investigator:
Nicholas J Nugent

Technology Maturity (TRL)

Start: **1**
Current: **1**
Estimated End: **3**



Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
  - TX13.1 Infrastructure Optimization
    - TX13.1.1 Natural and Induced Environment Characterization and Mitigation

Images

Office of the Chief Technologist
Logo for the Office of the Chief Technologist
(https://techport.nasa.gov/image/4011)